PATENT

ELECTRONIC GAMING MACHINE WITH ARCHITECTURE SUPPORTING A VIRTUAL DEALER AND VIRTUAL CARDS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the field of gaming, the field of casino table gaming, the field of casino table card gaming, and to electronic or computer-based systems that can approach or achieve complete automation of a casino table game, including the elimination of a live dealer.

2. Background of the Art

In the gaming industry, significant gambling occurs at live table games that use playing cards and a live dealer. Exemplary live table games include blackjack, poker, poker variants such as Let It Ride® stud poker, baccarat, casino war and other games. There are a number of proprietary or specialty live table card games which have developed, such as pai-gow poker, Let-It-Ride® stud poker, Three Card Poker® game, Four Card Poker® game, Caribbean Stud® poker and others. These and many other games all involve play using playing cards. The cards are dealt by a live dealer to the players, to a flop and/or to the dealer. The use of playing cards provided by a live dealer has a number of associated limitations and disadvantages that have long plagued the casino industry. Some of these are of general concern to all or most playing card games. Others are problems associated with the use of playing cards in particular games. Some of the principal concerns and problems are discussed below.

The use of playing cards at live table games typically involves several operational requirements that are time-consuming. These operations are conveniently described as collecting, shuffling, dealing and reading of the cards. In many card games there is also a step of cutting the deck after it has been shuffled. In the collecting operation, a live

dealer typically collects the cards just played at the end of a hand of play. This is done in preparation for playing the next hand of cards. The cards must often be collected in the specific order in which they had appeared in the play of the game and must also be collected in a specific orientation, such as all cards being in a facedown or face-up condition. The cards also are typically straightened into a stack with the long sides and short sides aligned. These manipulations take time and are not typically appreciated by either the dealer or players as enhancing the play and entertainment value of the game. The use of physical cards also adds a regular cost to play of the game in the wear on decks of cards that must be replaced every few hours. In many games the cards collected at the end of the hand are deposited in a discard rack that collects the played cards until the time a new stack is obtained or the stack is shuffled. In some games the cards are immediately shuffled into the stack either manually or using a card shuffling machine. More typically, the cards are collected and then shuffling is performed later by the dealer or a shuffling device controlled by the dealer.

When shuffling is needed, it involves a break in the action of the table game and consumes a significant amount of time. Shuffling is also the most time consuming operation in preparing for the next hand. Thus, shuffling is of substantial financial significance to the casino industry because it requires significant time and reduces the number of hands that can be played per hour or other period of time. The earnings of casinos are primarily dependent upon the total number of hands played. This is true because the casino on average wins a certain percent of the amounts wagered, and many or most casinos are open on a 24-hour basis. Thus, earnings are limited by the number of hands that can be played per hour. In light of this there has been a significant and keen interest by casino owners to develop practices that allow more games to be played in a given amount of time. Accomplishing this without detracting from the players' enjoyment and desire to play the game is a challenging and longstanding issue with casino owners and consultants in the gaming industry. The use of high quality shuffling machines, such as those produced by Shuffle Master, Inc. (Las Vegas, Nevada) as shown, for example, in U.S. Patents Nos. 6,655,684; 6,651,982; 6,588,751; 6,658,750; 6,568,678;

6,325,373; 6,254,096; 6,149,154; 6,139,014; 6,068,258; and 5,695,189 that have significantly reduced the problem in down time, but there is still the need for a human operator and a human dealer in the use of these shuffling devices for casino table games.

The amount of time consumed by collecting, shuffling and dealing is also of significance in private card games because it also delays action and requires some special effort to perform. In private games there is also some added complexity due to card players remembering or figuring out which player had previously dealt and who should now shuffle and re-deal the cards as needed.

In addition to the time delay and added activity needed to collect, shuffle and deal cards, there is typically some time devoted to cutting the deck of cards which have been shuffled and which are soon to be dealt. This traditional maneuver helps to reduce the risk that the dealer who has shuffled the cards may have done so in a way that stacks the deck in an ordered fashion that may favor the dealer or someone else playing the game. Although cutting the deck does not require a large amount of time, it does take some time. The amount of time spent on cutting also somewhat reduces the frequency at which hands of the card game can be played and introduces another physical step in which human error or design can be introduced, such as dropping and exposing the cards or cutting the deck in a specific position to control the outcome in a fixed deck.

In the gaming industry there is also a very significant amount of time and effort devoted to security issues that relate to play of the casino games. Part of the security concerns stem from frequent attempts to cheat during play of the games. Attempts to cheat are made by players, dealers, or more significantly by dealers and players in collusion. This cheating seeks to affect the outcome of the game in a way that favors the dealer or players who are working together. The amount of cheating in card games is significant to the casino industry and constitutes a major security problem that has large associated losses. The costs of efforts to deter or prevent cheating are very large and made on a daily basis. Many of the attempts to cheat in the play of live table card games involve some aspect of dealer or player manipulation of cards during collection, shuffling, cutting or dealing of cards. Thus, there is a need for methods and apparatus

that can be used in the play of live table card games that reduces the ability of the dealer and/or players to cheat by manipulation of playing cards. Of greatest concern are schemes whereby the deck is stacked and the stacked deck is used to the collusive player's advantage. Stacked decks represent huge potential losses since the player is aware of the cards which will be played before play occurs and can optimize winnings by increasing bets for winning hands and decreasing bets for losing hands. It is also desirable to provide decks or groups of cards where card counters are disadvantaged because of the reduction in their ability to track distributions of cards in the group of cards being used for play. Continuous shufflers, in which cards are reintroduced into the group of cards being used, the introduction being random throughout the entire group, helps to eliminate that aspect of improper behavior at the gaming table.

Casinos have recognized that their efforts to reduce cheating would be improved if the casino had comprehensive information on the cards which have been played, the amounts bet, the players and dealers involved and other information about actions which have taken place at the card tables. This is of particular importance in assessing the use of stacked decks. It is also important where card tracking is occurring. Additional explanation about card tracking is discussed below. The information desired by the casinos includes knowing the sequence and exact cards being dealt. It would be even more advantageous to the casino if physical cards and live dealers could be eliminated, as this would remove almost all major existing methods of fraud from casino table card games.

Some attempts have been made to record card game action. The best current technology involves cameras that are mounted above the tables to record the action of the card games. This approach is disadvantaged by the fact that not all cards dealt are easily imaged from a camera position above the table because some or all of the cards are not dealt face-up, or are hidden by overlying cards. Although many blackjack games are sufficiently revealing to later determine the order of dealt cards, others are not. Other card games, such as poker, have hands that are not revealed. The covered cards of the players do not allow the order of dealt cards to be ascertained from an above-table

camera or on table cameras, as exemplified by U.S. Patents Nos. 6,313,871 (Schubert); 5,781,647 (Fishbine); and numerous patents assigned to MindPlay LLC (e.g., U.S. Patent Nos. 6,663,490; 6,652,379; 6,638,161; 6,595,857; 6,579,181; 6,579,180; 6,533,662; 6,533,276; 6,530,837; 6,530,836; 6,527,271; 6,520,857; 6,517,436; 6,517,435; and 6,460,848.

Even where cameras are used, their use may not be effective. Such cameras may require time-consuming and tedious human analysis to go over the videotapes or other recordings of table action or require the use of software that is complex and imprecise. In some present systems, some human study may be needed just to ascertain the sequence of cards dealt or to determine the amount of betting or to confirm software determinations from camera read data. Such human analysis is costly and cannot economically be used to routinely monitor all action in a casino card room or table game pit.

For the above reasons, the video camera monitoring techniques have found very limited effectiveness as a routine approach for identifying cheating. There has also been relatively limited use as a serious analytical tool because of the difficulty of analysis. Such camera surveillance techniques are also of only limited effectiveness as a deterrent because many of the people involved with cheating have a working knowledge of their limitations and utilize approaches which are not easily detectible by such systems.

Another use of video camera monitoring and recording has been made in the context of analyzing card table action after someone has become a cheating or card counting suspect. The tape recordings serve as evidence to prove the cheating scheme. However, in the past, this has generally required other evidence to initially reveal the cheating so that careful analysis can be performed. More routine and general screening to detect cheating has remained a difficult and continuing problem for casinos. This is also a human intensive review, with both video monitoring security personnel and live personnel watching the players and apprehending players at the tables.

Another approach to reducing security problems utilizes card shoes having card detection capability. Card shoes hold a stack of cards containing typically from one to eight decks of cards. The cards are held in the card shoe in preparation for dealing and to

secure the deck within a device that restricts access to the cards and helps prevent card manipulations. Card shoes can be fit with optical or magnetic sensors that detect the cards as they are being dealt. Some of the problems of security analysis using above-table cameras is reduced when the sequence of cards dealt can be directly determined at the card shoe using optical or magnetic sensors.

One advantage of such card shoes is that the card sequence information can be collected in a machine-readable format by sensing the specific nature (suit and count) of each card as they are dealt out of the card shoe. However, most such card shoes have special requirements for the cards being used. Such cards must carry magnetic coding or are specifically adapted for optical reading. This increases the cost of the cards and may not fully resolve the problems and difficulties in obtaining accurate information concerning sequence information. The automated data collecting card shoes also do not have an inherent means for collecting data on the assignment of the card to a particular player or the dealer. They further do not collect data on the amounts bet. These factors thus require some other manual or partially automated data collection system to be used, or require that time-consuming human analysis be performed using video tapes as explained above.

The use in blackjack of numerous card decks, such as six decks, has been one strategy directed at minimizing the risk of card tracking or counting, especially when the set of cards is cut relatively shallowly so that many cards are not allowed into play from the set. Such tracking should be contrasted with card counting strategies which are typically less accurate and do not pose as substantial a risk of loss to the casino. Use of numerous card decks in a stack along with proper cut card placement can also reduce the risk of effective card counting. However, it has been found that multiple decks are not sufficient to overcome the skilled gambler's ability to track cards and turn the advantage against the house.

Card tracking can be thought of as being of two types. Sequential card tracking involves determination of the specific ordering of the card deck or decks being dealt. This can be determined or closely estimated for runs of cards, sequences of cards forming

a portion or portions of a stack. Sequential card tracking can be devastating to a casino since a player taking advantage of such information can bet large in a winning situation and change the odds in favor of the player and against the casino.

Slug tracking involves determining runs of the deck or stack that show a higher frequency of certain important cards. For example, in the play of blackjack there are a relatively large number of 10-count cards. These 10-count cards are significant in producing winning blackjack hands or 20-count hands that are also frequently winning hands. Gamblers who are proficient in tracking slugs containing large numbers of 10-count cards can gain an advantage over the house and win in blackjack.

There is also a long-standing problem in the play of blackjack which concerns the situation when the dealer receives a blackjack hand in the initial two cards dealt. If the dealer has a 10-count card or ace as the up card, then it is possible for the dealer to have a blackjack. If the dealer does have a blackjack, then there is no reason to play the hand out since the outcome of the hand is already determined without further dealing. If the hand is fully played out, and the dealer then reveals that the dealer has received a blackjack hand, then a significant amount of time has been wasted. It also causes players to often be upset when a hand is played out to no avail. In many casinos the waste of time associated with playing out hands with a winning dealer blackjack has lead to various approaches that attempt to end the hand after the initial deal. Some of these allow the dealer to look at the down card to make a determination whether a blackjack hand has been dealt to the dealer. This looking is commonly called "peeking" and is an operation that has been the source of numerous cheating schemes involving dealers and players who work in collusion. In such cheating associated with peeking at the down card, the dealer cheats in collaboration with an accomplice-player. This cheating is frequently accomplished when the dealer signals the accomplice using eye movements, hand movements or other signals. If a dealer does not peek, then he does not know the value of his hand until after the players have completed their play. If the dealer does peek, then he can use such eye movements, hand movements or other techniques to convey instructions to his accomplice-player. These signals tell the accomplice what

hand the dealer has been dealt. With this knowledge of the dealer's hand, the accomplice has improved odds of winning and this can be sufficient to turn the long-term odds in favor of the accomplice-player and against the casino. Many casinos do not allow the dealer to look at or inspect the down card until all insurance wagers have been made or declined.

There have also been a substantial number of apparatuses devised to facilitate the peeking procedure or render it less subject to abuse. Such peeking devices are intended to allow determination of whether the dealer has received a blackjack hand; however, this is done without revealing to the dealer what the down card is unless it makes a blackjack. Some of these devices require a special table with a peeking device installed in the table. Others allow the down card to be reviewed using a tabletop device in which the card is inserted. These systems and others involve the use of special playing cards. These devices and methods generally add greater costs and slow the play of the game. The slowed play often occurs to such a degree that it offsets the original purpose of saving the time associated with playing out possible dealer blackjack hands. The prior attempts have often ended up unacceptable and are removed.

Another notable problem suffered by live table games is the intimidation which many novice or less experienced players feel when playing such games. Surveys have indicated that many new or less experienced people who come to a casino are inclined to play slot machines and video card games. These people feel intimidation at a live table game because such games require quick thinking and decision making while other people are watching and waiting. This intimidation factor reduces participation in table games.

A further issue that has developed in the casino business is the public's increasing interest in participating in games that have a very large potential payoff. This may be in part a result of the large amount of publicity surrounding the state operated lotteries. News of huge payoffs is read with keen interest and creates expectations that gaming establishments should provide games with large jackpots. One approach has been the networked or progressive slot machines that use a centralized pool of funds contributed by numerous players. These slot machine systems are relatively more costly to purchase

and operate. For many gamblers, this approach is not particularly attractive. This lack of attractiveness may be due to the impersonal and solitary nature of playing slot machines. It may alternatively be for other reasons. Whatever the reason, the public is clearly interested in participating in games that can offer potential jackpots that are very large. Table card games have not been able to satisfactorily address this interest. The continued diminishment in the percent of people who play live table games indicates the need for more attractive games and game systems that address to public's interests.

Further problems associated with live table card games are the costs associated with purchasing, handling and disposal of paper and plastic playing cards. Casinos pay relatively favorable prices for card decks, but the decks roughly cost about $1 per deck at this time. Each casino uses decks for a very limited period of time, typically only one shift, and almost always less than one day. After this relatively brief life in the limelight, the decks are disposed of in a suitable manner. In some cases they can be sold as souvenirs. This is done after the cards are specially marked or portions are punched out to show they have been decommissioned from a casino. This special marking allows the cards to be sold as souvenirs while reducing the risk that they will later be used at the card tables in a cheating scheme which involves slipping a winning card into play at an appropriate point. In other cases the playing cards are simply destroyed or recycled to eliminate this last risk. In any case, the cost of playing cards for a casino is significant and can easily run in the hundreds of thousands of dollars per year.

In addition to the above problems, there are also significant costs associated with handling and storing the new and worn playing cards. Sizable rooms located in the casino complexes are needed just to store the cards as they are coming and going. Thus, the high costs of casino facilities further exacerbate the costs associated with paper and plastic playing cards.

The most significant cost in operation of gaming apparatus is personnel costs. A number of attempts have been made to reduce time requirements for not only the dealers, relief dealers, but also for the supervisors, managers, security and the other staff that are directly or indirectly involved in the operation or maintenance of the games.

A number of attempts have been made to design and provide fully automated gaming machines that duplicate play of casino table card games. These attempts have ranged from and included the highly successful video poker slot games to the mildly successful slot-type blackjack game (for single players). In those systems, the individual player sits at an individual machine, inserts credits/currency/coins, and plays a one-on-one game that is controlled by a processor in the machine or to which the machine is distally connected (networked). These machines are common in casinos, but do not duplicate the ambience of the casino table game with multiple players present.

Another type of attempt for simulating casino table card games is the use of a bank of individual player positions associated with a single dealer position in an attempt to simulate the physical ambiance of a live casino table card game. Such systems are shown in U.S. Patents Nos. 4,397,509 (Miller); 4,614,342 (Takashima); 4,995,615 (Cheng); 5,470,080 (Naku); and Published U.S. Patent Applications 2002/0169013 (Serizawa); 2003/0199316 (Miyamoto); and the like. These systems have a video display of a dealer and have individual monitors for display of the players' hands and the dealer hands. The architecture of these systems has generally been designed on a unique basis for each game, and there tends to be a main computer/processor that drives all elements of the game, or two computers/processors that distribute the video control of the dealer image and the remainder of the game elements between the two distinct computer/processors. This tends to maximize the cost of the system and tends to provide a slow system with high processing power demands to keep the operation working at speeds needed to maximize use and profit from the machines.

Sines, U.S. patents 6,651,985 and 6,270,404 are titled "Automated system for playing live casino table games having tabletop changeable playing card displays and play monitoring security features". Sines U.S. Patent 6,165,069 is similarly titled "Automated system for playing live casino table games having tabletop changeable playing card displays and monitoring security features."

The latter two patents (6,270,404 and 6,165,069) are related as continuations and therefore have identical disclosures. U.S. Patent 6,651,985 claims continuation-in-part status from the earliest application (U 6,165,069.

Sines, U.S. Patent 6,651,985, describes the use of a live dealer, even though virtual cards are used. There is no virtual dealer display and no software or architecture controls needed for a virtual dealer display. There are distinct display components for the players' hands and dealer's hand. Looking at Figures 23, 24 and 25 (which are identical to the same figures in U.S. Patent 6,651,895, discussed above), it appears that at least for betting functions, the system operates with parallel communication to the player input stations. (See wire connections shown in Figures 24 and 25 to the Player Bet Interfaces **196, 198, 201** and **203**.) These Bet Interface Circuits (an alternative description in the text, at column 14, lines 29-56 and column 15, lines 5-12) do not indicate that these are anything more than circuits, and no processing intelligence is specifically disclosed. This appears to be merely an interface with player controls without any processing function disclosed. The Sines' system in these patents also requires bet sensors on the table.

U.S. Patent No. 6,607,443 (Miyamoto et al., Kabushiki Kaisha SEGA Enterprises) and Published U.S. Application 2003/0199316 A1 (also KKSE) and particularly Figures 1, 2, 3, 7, 9, 10, 11, 12 and 13, discloses a virtual blackjack table system. The main objective of this patent is to have optical data that enables the SEGA system to read hand signals of players, such as calls for hits and Stand signals. The hardware architecture in Figure 15, as described in the specification at column 11, lines 29-54 show that there are distinct CPU's for the (audio and video, **280, 281, 282, 283**) which is driven by the Sub-CPU, which is turn connected to the main CPU (**201**), with an additional sub-CPU **204** directing the motion sensor system **13**, **14**, **15**, **16**, and **32**. There are distinct processing blocks for the sound (**22**), the video (**21**), the main CPU (**20**), and the subsystems (**13**), as well as the components already noted for the motion sensors/facial recognition sensors system.

U.S. Patent No. 5,221,083 (Dote, SEGA Enterprises, Ltd.) describes a blackjack automated game system that has a reflected video image of a dealer and also has

individual satellite player positions, with individual CRT monitors for each player. There is no disclosure of the type of information processing hardware in the system.

U.S. Patent Nos. 5,934,998 (Forte and Sines, unassigned) and 5,586,766 (Forte and Sines, assigned to Casinovations, Inc.) describe the use of physical cards and a physical dealer, with no dealer display, on a blackjack table that has a CPU driven system. Figures 6-10 show circuit construction and hardware considerations in the design of the system, including communication architecture. This system provides a count display (e.g., LED display) at each player position to show the player count and dealer count (as appropriate) that is determined from reading of the physical cards. Physical playing chips are also used, with no credit wagering capability shown.

U.S. Patent No. 5,159,549 describes a system that provides a multiple player game data processing unit with wager accounting. There are distinct player stations with player input on wagering. There may be a limited amount of intelligence at player stations (see column 4, line 1 through column 7, line 55), but there are multiple lines to each player station.

U.S. Patent No. 4,614,342 (Takashima) teaches an electronic game machine with distinct display units (CRT screens) at the player positions and the dealer position. The dealer screen (**10**) does not show an image of a dealer, but shows the dealer's card(s) and game information. There are typical player input controls (**16**) at each player position. The system provided is more like a bank of slot systems than a card table. In addition to a dealer data processor (**6**), each player position includes a player data processor CPU (**30**) with player memory (**32**). The central dealer computer apparently polls the individual player data processors to obtain the status of the events at each position (column 4, lines 1-60; and column 3, lines 8-17).

U.S. Patent No. 5,586,936 (Bennett et al., assigned to Mikohn Gaming) teaches a ticketless control system for monitoring player activity at a table game, such as blackjack. Physical cards and physical chips are shown. Player identity cards identify each player entering play at a table, and a separate ticket printer issues a results ticket (**500**) at the end of play or reads the ticket at the beginning of play. There is no distinct intelligence

apparent at each player position, and there is a central CPU that controls the system (e.g., Figure 8). Physical chips and a real dealer are apparently used. A phone line (**630**) is connected from each player position to the CPU (**820**) through a communications port (**814**).

U.S. Patent No. 4,995,615 (Cheng) describes a method and apparatus for performing fair card play. There are individual player positions with individual screens (**12**) provided for each player. There are three vertical, card-display screens (**11**, **13**, **11**) shown for "receiving instructions from the computer to display sequentially the cards being distributed throughout the processing of the play..." (Column 4, lines 4-13). There is no visual display of a dealer, there are individual player image panels, and no details of the architecture are shown or described.

U.S. Patents Nos. 5,879,235; 5,976,019; and 6,394,898, assigned to SEGA Enterprises, Ltd. relate to non-card game systems, such as horse race simulators or ball game simulators (e.g., roulette). There is no dealer or croupier simulation. The horse race simulator is an automated miniature track with physically moving game elements. The point of interest is in evaluating the architecture to see how the intelligence is distributed between the player stations and the wagering screen. The system again shows individual monitors at each player position (**80, 81**) and no dealer display. The schematics of the electrical architecture in Figure 11 shows a main board that also includes a Picture Control Section (**95**), Sound Control Section (**96**), and a communication control section (**107**). There is a distinct picture output board (**108**).

It is desirable to provide a system that meets both the structural and play ambience requirements for a successful, fully automated interactive gaming system for playing casino table wagering games with cards that does not require any attendant personnel in its operation.

SUMMARY OF THE INVENTION

A gaming system simulates complete play of events in a casino table card wagering game, such as blackjack, poker, poker variants, baccarat, and other wagering games where there has traditionally been a dealer, whether or not the dealer is an active

player in the game. Two distinct video areas are preferably provided, one relatively upright video display providing video images of a dealer, and the second relatively horizontal video display providing a simulation of a table top for player cards, and optionally also dealer cards. The players have individual play areas with player input, and these play areas have individual processing intelligence that communicates directly with a main game computer in a novel manner.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 shows a perspective view of a prior art format for an automated gaming system.

Figure 2 shows an overhead view of a prior art format for an automated gaming system.

Figure 4 shows a block schematic of the electronic configuration of a prior art animated gaming system.

Figure 3 shows a side view of a prior art format for an automated gaming system.

Figure 5 shows a perspective view of a format for an automated gaming system according to the present invention.

Figure 6 shows a frontal view of a gaming engine useful in the practice of the present invention.

Figure 7 shows a schematic of a player station useful in the practice of the present invention.

Figure 8 shows a schematic of a preferred embodiment of a game display useful in the practice of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

It should be first understood that in the description of the practices, methods, components, subcomponents and apparatus of the present invention, the examples and specific materials identified are merely exemplary and are not intended to be taken as limits in the practice of the invention. For example, any computer language may be used,

any operating system may be used, any commercial or specially designed hardware that can perform the identified functions and provides the described properties can be used, even if the specific component described is or is not a preferred embodiment of the invention.

A gaming system according to the present invention comprises a table and a dealer "virtual" video display system positioned for view by players seated at the table. The table may seat at least two players up to the amount of players that can be configured about the table and have a view of the dealer video display system. Typically each gaming system will have at least four player available positions, with space determinations considered as to whether there would be 4, 5, 6 or 7 player positions. It is possible to have a completely circular dealer display (e.g., holographic display in a cylindrical centerpiece) and have players distributed around the entire periphery, but this is too dissimilar to standard play arrangements and could slow the game down, as play should approximate that of a live game, with players playing in sequence. A surface of the table will have a generally continuous display surface for showing players' hands (and possibly dealer hands) and, where there are touch screen player controls, for displaying the player touch screen controls. A majority of the table surface comprises a video monitor in one example of the invention. Where there are no touch screen controls, the continuity of the surface may be interrupted by inserted player control panels. The use of a continuous (except for possible interruption by the above indicated panels) display surface offers some significant advantages in simulating or recreating a standard card table surface. Cards may be readily viewed by other players at a blackjack table, which is standard in table games. Individual monitors, especially where slanted towards the individual players make such table-wide card reading difficult. The use of the full screen (continuous) display also allows for better animation to be provided, such as displaying virtual images of cards moving to the player and "virtual" chips being placed on the table when wagers are indicated. For purposes of this disclosure, the term "virtual" means a graphical video representation of a real object or person, such as a dealer, cards and chips, for example.

The individual player positions have a separate intelligence at each player position that accepts player input and communicates directly with a game engine (main game computer or processor). The intelligence is preferably an intelligent board that can process information. For purposes of this disclosure the term "intelligent" refers to the ability to execute code, either provided in the form of software or hardware circuits. Such processing may at least comprise some of signal converting (e.g., signals from player card readers, credit deposit, currency readers, coin readers, touch screen signals, control panel signals) into a signal that can be included in an information packet and interpreted by the main game computer when the signal is sent. Communication between the intelligence at each player position is direct to the main game computer and may be by self-initiated signal sending, sequenced polling by the main game computer (e.g., each position communicates directly to the main game computer in turn), timed communication, or any other order of communication that is direct between the intelligence and the main game computer. One preferred form of communication between the main game computer and player station computers is by means of self-initiated signal sending. There is essentially a single main game computer that contains video display controls and programs for both the dealer display and the table top display, audio controls and programs, game rules (including storage of multiple games if intended to be available on the machine), random number generator, graphic images, game sequence controls, security systems, wager accounting programs, external signaling and audit functions, and the like. In other forms of the invention, the above functions are divided between a main processor and one or more additional processors. The intelligence at each player position speeds up the performance of all aspects of the game by being able to communicate directly with the main game computer and being able to process information at the player position rather than merely forwarding the information in raw form to the main game computer. Processing player information at player positions frees up resources for use by the main processor or processors.

A card game system may also include suitable data and control processing subsystem that is largely contained within a main control module supported beneath the

tabletop. The control and data processing subsystem 90 includes a suitable power supply for converting alternating current from the power main as controlled by a main power switch. The power supply transforms the alternating line current to a suitable voltage and to a direct current supply. Power is supplied to a power distribution and sensor/activity electronics control circuit. Commercially available power switching and control circuits may be provided in the form of a circuit board which is detachable, and plugs into a board receptacle of a computer mother board or an expansion slot board receptacle. A main game controller mother board may include a central microprocessor and related components well-known in the industry as computers using Intel brand Pentium microprocessors and related memory or intelligence from any other manufacturing source. A variety of different configurations and types of memory devices can be connected to the motherboard as is well known in the art. Of particular interest is the inclusion of two flat panel display control boards connected in expansion slots of the motherboard. Display control boards are each capable of controlling the images displayed for the dealer video display and for each of the player position display areas on the continuous display screen on the table and other operational parameters of the video displays used in the gaming system. More specifically, the display control boards are connected to player bet interfaces circuits for the player stations. This arrangement also allows the display control boards to provide necessary image display data to the display electronic drive circuits associated with the dealing event program displays and the dealer display.

The motherboard and/or the individual player intelligent boards also includes a serial port that allows stored data to be downloaded from the motherboard to a central casino computer or other additional storage device. In one example of the invention, each player board communicates directly with the casino computer system. This allows card game action data to be analyzed in various ways using added detail, or by providing integration with data from multiple tables so that cheating schemes can be identified and eliminated, and player tracking can be maintained. Player performance and/or skill can be tracked at one table or as a compilation from gaming at multiple tables, as by using

Bloodhound™ security software marketed by Shuffle Master, Inc., which may be incorporated into this automated gaming system. Additionally, player hand analysis can be performed. The motherboard and/or individual player intelligent boards may also have a keyboard connection port that can be used to connect a larger format keyboard to the system to facilitate programming and servicing of the system.

Although the preferred system shown does not require features illustrated for receiving automated player identification information, such features can alternatively be provided. Card readers such as used with credit cards, or other identification code reading devices can be added in the system to allow or require player identification in connection with play of the card game and associated recording of game action by one of the processors. Such a user identification interface, for example a card reader located at each player station, can be implemented in the form of a variety of magnetic card readers commercially available for reading a user-specific identification information. The user-specific information can be provided on specially constructed magnetic cards issued by a casino, or magnetically coded credit cards or debit cards frequently used with national credit organizations such as VISA, MASTERCARD, AMERICAN EXPRESS, casino player card registry, banks and other institutions.

Alternatively, it is possible to use so-called smart cards to provide added processing or data storage functions in addition to mere identification data. For example, the user identification could include coding for available credit amounts purchased from a casino. As further example, the identification card or other user-specific instrument may include specially coded data indicating security information such as would allow accessing or identifying stored security information which must be confirmed by the user after scanning the user identification card through a card reader. Such security information might include such things as file access numbers which allow the central processor to access a stored security clearance code which the user must indicate using input options provided on displays using touch screen displays. A still further possibility is to have participant identification using a fingerprint image, eye blood vessel image reader, or other suitable biological information to confirm identity of the user that can be

built into the table. Still further it is possible to provide such participant identification information by having the pit personnel manually code in the information in response to the player indicating his or her code name or real name. Such additional identification could also be used to confirm credit use of a smart card or transponder. All or part of the functions dedicated to a particular player station are controlled by the player station intelligence in one form of the invention. Additionally, each player station intelligence may be in communication with a casino accounting system.

It should also be understood that the continuous screen can alternatively be provided with suitable display cowlings or covers that can be used to shield display of card images from viewing by anyone other than the player in games where that is desirable. This shielding can also be effected by having light-orientation elements in the panel, and some of these light-orientation elements are electronically controllable. In this manner, the processor can allow general viewing of cards in games where that is desirable or tolerated, and then alter the screen where desired. These types of features can be provided by nanometer, micrometer or other small particulate or flake elements within a panel on the viewing area that are reoriented by signals from the processor. Alternatively, liquid crystal or photochromic displays can be used to create a screening effect that would allow only viewers at specific angles of view from the screen area to view the images of cards. Such an alternative construction may be desired in systems designed for card games different from blackjack, where some or all of the player or dealer cards are not presented for viewing by other participants or onlookers. Such display covers or cowlings can be in various shapes and configurations as needed to prevent viewing access. It may alternatively be acceptable to use a player-controlled switch that allows the display to be momentarily viewed and then turned off. The display can be shielded using a cover or merely by using the player's hands. Still further it is possible to use a touch screen display that would be controlled by touch to turn on and turn off. Similar shielding can be used to prevent others from viewing the display.

A review of the figures will assist in a further understanding of the invention.

Figure 1 shows a fully automated gaming table **1** of the prior art, as disclosed in US Patent Application 2003/0199316. The system **1** comprises a vertical upright display cabinet **2** and a player bank or station cluster arrangement **3**. The vertical display cabinet **2** has a viewing screen **7** on which images of the virtual dealer are displayed. The top **8** of the player bank arrangement **3** has individual monitor screens **10** for each player position, as well and tabletop inserted coin acceptors **11**, and player controls **12** and **13**. There is a separate and larger dealer's hand screen **9** on which dealer cards are displayed in a format large enough for all players to view. Speakers **16a** and **16b** are provided for sound transmission and decorative lights **14** are provided. Figure 2 shows an overhead view of the same prior art automated gaming system **1** with the viewing screen **7** shown more clearly as a CRT monitor. It can also be seen that each player position has to form an arc cut into the semicircular player seating area **18**. Figure 3 shows a side view of the same prior art automated gaming system of Figures 1 and 2 where the orientation of the three different types of CRT monitors **7**, **9** and **10** are shown.

Figure 4 shows the schematic circuitry of a prior art automated system as disclosed in 2003/0199316. Figure 4 is a block diagram of processing circuitry in the game device of Figure 1. The game device housing comprises a CPU block **20** for controlling the whole device, a picture block **21** for controlling the game screen display, a sound block for producing effect sounds and the like, and a subsystem for reading out CD-ROM.

The CPU block **20** comprises an SCU (System Control Unit) **200**, a main CPU **201**, RAM **202**, RAM **203**, a sub-CPU **204**, and a CPU bus **205**. The main CPU **201** contains a math function similar to a DSP (Digital Signal Processing) so that application software can be executed rapidly.

The RAM **202** is used as the work area for the main CPU **201**. The RAM **203** stores the initialization program used for the initialization process. The SCU **200** controls the busses **205**, **206** and **207** so that data can be exchanged smoothly among the VEPs **220** and **230**, the DSP **241**, and other components.

The SCU **200** contains a DMA controller, allowing data (polygon data) for character(s) in the game to be transferred to the VRAM in the picture block **21**. This allows the game machine or other application software to be executed rapidly. The sub-CPU **204** is termed an SMPC (System Manager & Peripheral Control). Its functions include collecting sound recognition signals from the sound recognition circuit **15** or image recognition signals from the image recognition circuit **16** in response to requests from the main CPU **201**. On the basis of sound recognition signals or image recognition signals provided by the sub-CPU **204**, the main CPU **201** controls changes in the expression of the character(s) appearing on the game screen, or performs image control pertaining to game development, for example. The picture block **21** comprises a first VPD (Video Display Processor) **220** for rendering TV game polygon data characters and polygon screens overlaid on the background image, and a second VDP **230** for rendering scrolling background screens, performing image synthesis of polygon image data and scrolling image data based on priority (image priority order), performing clipping, and the like. The first VPD **220** houses a system register **220a**, and is connected to the VRAM (DRAM) **221** and to two frame buffers **222** and **223**. Data for rendering the polygons used to represent TV game characters and the like is sent to the first VPD **220** through the main CPU **220**, and the rendering data written to the VRAM **221** is rendered in the form of 16- or 8-bit pixels to the rendering frame buffer **222** (or **223**). The data in the rendered frame buffer **222** (or **223**) is sent to the second VDP **230** during display mode. In this way, buffers **222** and **223** are used as frame buffers, providing a double buffer design for switching between rendering and display for each individual frame. Regarding information for controlling rendering, the first VPD **220** controls rendering and display in accordance with the instructions established in the system register 220a of the first VPD **220** by the main CPU **201** via the SCU **200**.

The second VDP **230** houses a register **230a** and color RAM **230b**, and is connected to the VRAM **231**. The second VDP **230** is connected via the bus **207** to the first VPD **220** and the SCU **200**, and is connected to picture output terminals Voa through Vog through memories **232a** through **232g** and encoders **260a** through **260g**. The picture

output terminals Voa through Vog are connected through cables to the display **7** and the satellite displays **10**.

Scrolling screen data for the second VDP **230** is defined in the VRAM **231** and the color RAM **230b** by the CPU **201** through the SCU **200**. Information for-controlling image display is similarly defined in the second VDP **230**. Data defined in the VRAM **231** is read out in accordance with the contents established in the register **230a** by the second VDP **230**, and serves as image data for the scrolling screens that portray the background for the character(s). Image data for each scrolling screen and image data of texture-mapped polygon data sent from the first VPD **220** is assigned display priority (priority) in accordance with the settings in the register **230a**, and the final image screen data is synthesized.

Where the display image data is in palette format, the second VDP **230** reads out the color data defined in the color RAM **230b** in accordance with the values thereof, and produces the display color data. Color data is produced for each display **7** and **9** and for each satellite display **10**. Where display image data is in RGB format, the display image data is used as-is as display color data. The display color data is temporarily stored in memories **232a-232f** and is then output to the encoders **260a-260f**. The encoders **260a-260f** produce picture signals by adding synchronizing signals to the image data, which is then sent via the picture output terminals Voa through Vog to the display **7** and the satellite displays **10**. In this way, the images required to conduct an interactive game are displayed on the screens of the display **7** and the satellite displays **10**.

The sound block 22 comprises a DSP **240** for performing sound synthesis using PCM format or FM format, and a CPU **241** for controlling the DSP **240**. Sound data generated by the DSP **240** is converted into 2-channel sound signals by a D/A converter **270** and is then presented to audio output terminals Ao via interface **271**. These audio output terminals Ao are connected to the input terminals of an audio amplification circuit. Thus, the sound signals presented to the audio output terminals Ao are input to the audio amplification circuit (not shown). Sound signals amplified by the audio amplification circuit drive the speakers **16a** and **16b**. The subsystem **23** comprises a CD-ROM drive

19b, a CD-I/F **280**, and CPU **281**, an MPEG-AUDIO section **282**, and an MPEG-PICTURE section **283**. The subsystem **23** has the function of reading application software provided in the form of a CD-ROM and reproducing the animation. The CD-ROM drive **19b** reads out data from CD-ROM. The CPU **281** controls the CD-ROM drive **19b** and performs error correction on the data read out by it. Data read from the CD-ROM is sent via the CD-I/F **280**, bus **206**, and SCU **200** to the main CPU **201** that uses it as the application software. The MPEG-AUDIO section **282** and the MPEG-PICTURE section **283** are used to expand data that has been compressed in MPEG (Motion Picture Expert Group) format. By using the MPEG-AUDIO section **282** and the MPEG-PICTURE section **283** to expand data that has been compressed in MPEG format, it is possible to reproduce motion picture. It should be noted herein that there are distinct processor for the CPU block, video block, sound block, CD-ROM drive and Memory with their independent PCU's. This requires significant computing power and still has dumb (no intelligence) player input components.

Figure 5 shows an example of an automated table system **101** of the present invention. The system **101** has an upright dealer display cabinet **102** with a top **104** and the dealer viewing screen **107** which may be any form of display screen such as a CRT, plasma screen, liquid crystal screen, LED screen or the like. The player bank arrangement **103** has a continuous display screen **109** on which images of cards being dealt **105**, dealer's cards **108**, bets wagered **111** and touch screen player input functions **110** are displayed. Other player input functions may be provided on a panel **106** which might accept currency, coins, tokens, identification cards, player tracking cards, ticket in/ticket out acceptance, and the like.

Figure 6 shows an electronic/processor schematic for a MultiPlayer Platform (MPP) gaming system according to the present invention. The MPP Game engine (dealer) comprises a Heber Pluto 5 casino game board **200** (Motorola 68340 board) operating off the PC Platform Pentium 4 MPP Game Display processor **202**. The game display processor operates on a Windows XP platform. The respective subcomponents on the Pentium 4 processor are labeled to show the apportionment of activity on the

motherboard and the component parts added to the board. As is shown, the game engine has an Uninterruptible Power Supply **204**. The game display processor directs activity on the Speakers, directs activities onto the MPP Game Service panel, and the Plasma Monitor Card Table display. It is important to note that all communications are direct from the game display processor, freeing up resources available to the game engine processor.

Figure 7 shows the electronic/processing schematics of the MPP Player Station Intelligence board (Heber Pluto 5 Casino, Motorola 68340), each of which player stations (one for each player position) is in direct connection to the MPP Game Engine (Dealer), which is in turn directly connected to the PC Platform. (not shown in this Figure). Each Intelligence board receives information for all player input systems specific to that player station, such as the shown Coin Acceptor, Coin Hopper, Bill validator, Ticket Printer, Touch Screen and/or Display Button Panel, Dual Wire Ticket-in-Ticket-Out Printing and SAS System (SAS is one exemplary standard communications protocol used by a number of casinos central computer systems.) A significant benefit resides in the use of the independent Intelligence boards at each player position being in direct communication with the MPP Game Engine **300**, as opposed to each individual player position button panel being dead or inactive until authorized by the main game processor, as previous automated gaming systems were constructed.

The present invention is also an improvement in providing a system with not only the intelligence at each player position, but also in redistributing processing capability for functions among various processing components within the gaming system. In one architectural format, all functions of the gaming engine, except for the player localized intelligence functions, are consolidated into a single PC (e.g., the Pentium 4 shown in the Figures). This would include all game functions, player video functions, dealer video functions, dealer audio functions, security, central reporting (to a casino's central computer, for example), currency and debit functions, alarm functions, lighting functions, and all other peripherals on the system, except for the localized player functions. Alternatively, all functions requiring communication with the casino's main computer

system are located on the player station intelligent boards. In this system, the main game processor would talk directly with the player intelligent boards, preferably in the same novel communication format described below.

The alternative system is shown in Figures 6, 7 and 8, where there is a dealer engine processor intermediate the main game PC and the Player intelligent boards. Both systems are a distinct improvement over the prior art, but with the higher power available for PC's, and with the ease of programming a PC as opposed to an embedded system, the consolidation of the game functions and the ability of the main game engine to communicate with each of the player positions is enabled. As shown in Figure 8, the Game display processor **300** is preferably a Pentium 4 PC and is separate from the main processor. With the player intelligent boards, the main game PC can receive packets of information from each player station as events occur rather than having to poll each player position on a regular basis 100 times to gain the specific information for each player input that may be made.

A description of the Heber Board, (an exemplary board that can be used as a player station processor and/or game engine processor **16**) a commercially available intelligent processing board is as follows. The Heber Board is known for its reliability and flexibility, especially for the Pluto 5 family of gaming products. The Pluto 5 is the controller of choice for the global gaming industry. Flexibility comes from a set of features built into the Pluto 5 (Casino) controller, and from the choice of optional add-on boards that can be used to adapt the Pluto family to best suit individual applications. In the area of interfacing, there are three distinct boards, each of which serves a particular function in helping the Pluto 5 to connect with the world outside:

RS485 board

RS485 is an industrial-grade board for linking multiple systems in unforgiving circumstances for centralized information gathering. The Heber RS485 board is fully opto-isolated to provide complete circuit safety when used within 'electrically noisy' environments. The RS485 board uses a single RS232 connection to the Pluto 5 board and

all necessary power is also derived through this link. Two header connectors may be provided for the RS485 channel to allow daisy chain connections between multiple systems.

HII/ccTalk board

This board specializes in communicating with industry standard note/coin acceptors and payout hoppers. Equipped with dual communication channels, each port is configurable to use either the HII format to connect with Mars® coin/note acceptors or the ccTalk format for Money Controls® hoppers. Both channels are controlled via a single RS232 connection to the Pluto 5 board and all necessary power is also derived through this link. The Heber FastTrack package contains modular library functions for passing information via these channels.

Four channel relay board

The relay board allows control of medium- to high-level loads such as solenoids, without risk of damage or interference to the Pluto 5 circuitry. Four power-switching channels are available with absolute isolation from the Pluto 5 control signals. Each relay is capable of switching direct or alternating currents of up to 7A at a maximum voltage of 250V.

Like the Pluto 5 board itself, its modular options have been used extensively so that their designs are fully developed and entirely stable. The options that are specified are consistently provided in mass quantities. As with all Pluto products, programming for the modular options is straightforward. This is enhanced with the use of the Pluto 5 Enhanced Development Kit and also the FastTrack package. Between them, these kits contain all of the low level and high level programming tools and library functions needed for gaming applications. These systems can be provided through a Pluto 5 Enhanced Development Kit datasheet 80-15353-7

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Specifications for the various boards are identified below.

RS485 interface

Host interface

• RS232 connection to Pluto 5/Pluto 5 Casino

• All power provided via RS232 link from host system

Communication port

• Dual four-way Molex 0.1" KK headers for daisy chaining purposes

Dimensions

• 80 x 61mm (3.14 x 2.4")

Part number

• Opto-isolated RS485 board

01-14536-2

HII/ccTalk interface

Host interface

• RS232 connection to Pluto 5/Pluto 5 Casino

• All power provided via RS232 link from host system

Communication port

• Single or dual 10 way header connectors

Dimensions

• 101.6 x 69.85mm (4 x 2.8")

Part number

• Dual channel HII/ccTalk board

01-16171-2

Four channel relay board

Host interface

• Connection to Pluto 5/Pluto 5 Casino via ribbon cable using four standard output lines

• All power provided via ribbon cable link from host system

Switching capabilities

• Up to 250V AC or DC @ 7A maximum per channel

Dimensions

• 80 x 61mm (3.14 x 2.4")

Part number

• Four channel relay board

01-15275-1

80-16949-1

One proposed hardware configuration uses a "satellite" intelligent processor at each player position. The player station satellite processor is substantially the same as the primary game engine processor, a Heber Pluto 5 Casino board. The satellite processors receive instruction from the primary game engine but then handle the communications with player station peripherals independently. Each satellite processor communicates with only the peripherals at the same player station. Thus each player station has a dedicated satellite processor communicating with only the peripherals at the same player station and with the casino's central computer system. The peripherals are, but not limited to: Slot accounting Systems, Bill Validator, Ticket Printer, Coin Acceptor, Coin Hopper, Meters, Button panel or LCD touch screen and various doors and keys.

The satellite processors run proprietary software to enable functionality. The player station software is comprised of two modules, the first being an OS similar to the game engine Operating System and the second being station software that handles peripheral communications. The software may be installed on EPROMs for each satellite processor. The primary method of communication between the satellite processors and the primary game engine is via serial connectivity and the previously described protocol. In one example, information packets are prepared by the satellite processors and are sent to the game engine processor on the happening of an event.

The proposed game engine provides communication to the player stations to set the game state, activate buttons and receive button and meter information for each player

station. Communication is via a serial connection to each of the stations. The new protocol for communication between the game engine, game display and player stations is an event driven packet-for-packet bi-directional protocol with Cyclic Redundancy Check (CRC) verification. This is distinguished from the Sega system that used continuous polling. This communication method frees up resources in the same engine processor because the processor no longer needs to poll the satellites continuously or periodically.

The new protocol uses embedded acknowledgement and sequence checking. The packet-for-packet protocol uses a Command Packet, Response Packet and a Synchronization Packet as illustrated below. The protocol uses standard ASCII characters to send data and a proprietary verification method.

Format of Command Packet

STX	SEQ	DATA LENGTH	DATA	CRC-16	ETX
1	1	3	3-999	5	1

Format of Response Packet

STX	SEQ	DSP	PRV	ETX
1	1	1	1	1

Format of Synchronization Response Packet

STX	MTS	MRS	ETX
1	1	1	1

Legend For Figures

STX	Start of Packet Character
SEQ	Sequence # (Cycles from '0' thru '9')
LEN	Length of Data Area ('003' thru '999')
DATA	ASCII Data Fields Separated with '|' Character
CRC	CRC-16 Value ('0000' thru '65535') Cyclic Redundancy Check
ETX	End of Packet Character
DSP	Disposition Code ('A' ACK, 'N' NAK, or 'I' Invalid Sequence)
PRV	Sequence Number of Last ACK'ed Packet (0 thru 9)
MTS	Main's Current Transmit Sequence Number
MRS	Main's Current Receive Sequence Number

The Command Packet and Response Packet are used during primary game communications. The protocol uses redundant acknowledgement. For example: The packet is initially acknowledged when first received by the recipient. The same recipient will resend anther acknowledgement in the next communication. This second acknowledgement is the 'PRV' data in the response packet.

The communications between the Game Engine and the Player Station intelligence is preferably a transaction-based protocol. Either device can start a transaction, which is why it is essential that there be an intelligent board at each player position. All packets of information may be sent in any acceptable format, with ASCII format preferred as a matter of designer choice. All command packets usually contain a sequence number that is incremented after each successful packet exchange. The Game Engine and the Player Station intelligence use sequence numbers that are independent of each other. The sequence number keeps the communications in synchronization. This synchronization method is described later.

The command packet is used to send various commands such as Inputs, Lamps, Doors, Errors, Chirp, Game Results, player input, coin acceptance, player identification, credit acceptance, wagers, etc... The command packet format may be, by ay of a non-limiting example:

<STX><Sequence number><Data Length><Data><CRC-16><ETX>

The data format with in the command packet may be:

<Address><Command><Field 1>|<Field 2>|<Field n>|

The response packet format may be:

<STX><Sequence number><Disposition><Previous ACK><ETX>

The sync request packet format may be:

<SYN>

The sync response packet format may be:

<STX><Mains Current Transmission Sequence><Mains Current Receive Sequence><ETX>

A major strength of the protocol is its resilience of the Game Protocol and its ability to free up resources within the game engine. Those resources can in turn be used to provide more intricate games, and multi-media affects.

Synchronization Method:

The satellite and host must become synchronized in order to provide for reliable communications using packet numbers. To facilitate this, a novel protocol synchronization method that is used. Upon applying power to the satellite, or after a communications failure, the satellite automatically enters into synchronization mode. In the synchronization mode the satellite sends out the ASCII SYN (0x16) character about every second. It is expecting a special response packet containing transmit and receive packet sequence numbers to be used from that point on. After receiving the special response packet, the sequence numbers are used as-is, and not incremented until the a successful packet exchange. After communications is synchronized, the sequence numbers are incremented after each packet is successfully sent or received.

As was noted before, the main game processor may contain information, data, programming and other necessary functions to enable the play of multiple games off the same machine. For example, the main game engine may have rules and commands that will enable play of Blackjack, Let It Ride® poker, Three-Card™ poker, Four-Card™ poker, Caribbean Stud® poker, Spanish 21® blackjack, baccarat, Pai Gow poker, and other card games. The system may be controlled so that different games may be played at different times on command of the casino or players.

All of the apparatus, devices and methods disclosed and claimed herein can be made and executed without undue experimentation in light of the present disclosure. While the apparatus, devices and methods of this invention have been described in terms of both generic descriptions and preferred embodiments, it will be apparent to those skilled in the art that variations may be applied to the apparatus, devices and methods described herein without departing from the concept and scope of the invention. More specifically, it will be apparent that certain elements, components, steps, and sequences

that are functionally related to the preferred embodiments may be substituted for the elements, components, steps, and sequences described and/or claimed herein while the same of similar results would be achieved. All such similar substitutions and modifications apparent to those skilled in the art are deemed to be within the scope and concept of the invention as defined by the appended claims.